



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/049,650	05/02/2002	Ronald Kates	100564-00102	7878

6449 7590 11/23/2004

ROTHWELL, FIGG, ERNST & MANBECK, P.C.
1425 K STREET, N.W.
SUITE 800
WASHINGTON, DC 20005

EXAMINER

HIRL, JOSEPH P

ART UNIT	PAPER NUMBER
----------	--------------

2121

DATE MAILED: 11/23/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/049,650

Applicant(s)

KATES ET AL.

Examiner

Joseph P. Hirl

Art Unit

2121

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-11 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 02 May 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. ____.
 - ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date ____.
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: ____.

DETAILED ACTION

1. This Office Action is in response to an AMENDMENT entered September 28, 2004 for the patent application 10/049,650 filed on May 2, 2002.
2. The First Office Action of March 25, 2004 is fully incorporated into this Final Office Action by reference.

Status of Claims

3. Claims 1-11 are amended. Claims 1-11 are pending.

Claims Objections

4. Claim 5 is objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent claim should refer to other claims in the alternative only. While one use in a claim of the phrase "either of actions a3) and b3)" would be acceptable, multiple usage of the same phrase violates the concept of reference in the alternative only. See MPEP § 608.01(n). Accordingly, the claim 5 has not been further treated on the merits.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1-11 are rejected under 35 U.S.C. 102(b) as being anticipated by Mehrotra et al (MIT Press, 1997, referred to as **Mehrotra**).

Claim 1

Mehrotra anticipates identifying and eliminating synapses that have no significant influence on the curve of the risk function (**Mehrotra**, p 116, l 8-19; p 118, l 4-5; Examiner's Note (EN): para 15 applies; curve of the risk function is synonymous with Mehrotra's error analysis), including a1) selecting first and second sending-neurons that are connected to the same receiving neuron by respective first and second synapses (**Mehrotra**, p, 19, Fig. 1.14; p 116, l 31-32), a2) assuming a correlation of response signals from said first and second sending neurons to the same receiving neuron (**Mehrotra**, p 19, Fig. 1.14; p 46, Fig. 2.5), a3) interrupting the first synapse and adapting in its place a weight of the second synapse (**Mehrotra**, p 19, Fig. 1.14; p 117, Fig. 4.6; EN: the weight of the second synapse is the result of the removal of the first synapse), a4) comparing the output signals of the neural network changed in accordance with action a3) with the output signals of the unchanged neural network (**Mehrotra**, p 19, Fig. 1.14; p 116, l 33-34; p 117, Fig. 4.6), and a5) if the comparison

Art Unit: 2121

result does not exceed a predetermined level, eliminating the first synapse thereby simplifying the structure of the neural network (**Mehrotra**, p 19, Fig. 1.14; p 118, I 1-5).

Claim 2

Mehrotra anticipates wherein the first and second selected sending neurons are located on the same layer (**Mehrotra**, p 19, Fig. 1.14).

Claim 3

Mehrotra anticipates further comprising adapting a value of a bias of the receiving neuron in action a3) (**Mehrotra**, p 19, Fig. 1.14; p 116, I 33-34, p117, I 10-11).

Claim 4

Mehrotra anticipates identifying synapses that have no significant influence on the curve of the risk function further includes b1) selecting a synapse (**Mehrotra**, p 117, I 1-9; EN: para 15 applies; curve of the risk function is synonymous with Mehrotra's error analysis), b2) assuming that said selected synapse does not have a significant influence on the curve of the risk function (**Mehrotra**, p 117, I 1-9), b3) interrupting selected said synapse (**Mehrotra**, p 117, I 1-9), b4) comparing the output signals of the neural network changed in accordance with action b3) with the output signals of the unchanged neural network (**Mehrotra**, p 117, I 1-9), and b5) if the comparison result does not exceed a predetermined level, eliminating the selected synapse, further simplifying the structure of the neural network (**Mehrotra**, p 117, I 1-9).

Claim 6

Mehrotra anticipates calculating a value of a likelihood function for the neural network to represent the expected output of the neural network (**Mehrotra**, p 118, l 1-5; EN: para 15 applies; Mehrotra' ΔE is synonymous with a likelihood function).

Claim 7

Mehrotra anticipates comparing structure variants of the neural network using a significance test (**Mehrotra**, p 118, l 1-5; EN: para 15 applies; Mehrotra' ΔE check against a threshold is a significance test).

Claim 8

Mehrotra anticipates the structure variants of the neural network are compared using a CHI-SQUARED test (**Mehrotra**, p 118, l 1-5; EN: para 15 applies; CHI-SQUARED test is a measure of the deviation from the expectation as is Mehrotra' ΔE check against a threshold).

Claim 9

Mehrotra anticipates structure variants of the neural network are compared using a BOOT-STRAPPING method (**Mehrotra**, p 117, l 1-9; EN: para 15 applies; BOOT-STRAPPING is a sampling method for estimating values that would be difficult to infer analytically; Mehrotra check against a threshold functions in a synonymous way).

Claim 10

Mehrotra anticipates that, to compare two structure variants of the neural network includes calculating the ratio of the values of the likelihood functions for said two structure variants (**Mehrotra**, p 118, l 1-5; EN: para 15 applies; a ratio test will vary

from zero to infinity with unity as the point of equality; similarly, Mehrotra's ΔE check against a threshold will accordingly vary in a similar fashion where the threshold is equivalent to the applicants unity value).

Claim 11

Mehrotra anticipates optimizing the strengths of the connections between the neurons, according to a simplex method (**Mehrotra**, p 117, I 1-9; EN: para 15 applies; Mehrotra's selective node removal represents optimization of the Mehrotra's initial network since Mehrotra's goal is a pruned (optimized); Mehrotra's hyperplane adjustments made in Fig. 4.6 are synonymous to the simplex method of the inventor).

Response to Arguments

7. The abstract objection under 37 CFR 1.72(b) is withdrawn.
8. The objection to the specification under MPEP 608.01(a) is withdrawn.
9. The rejections of claims 1-11 under 35 USC 101 are withdrawn.
10. The rejections of claims 1-11 under 35 USC 112, first paragraph, are withdrawn.
11. The rejections of claims 1-11 under 35 USC 112, second paragraph, are withdrawn.
12. Applicant's arguments filed on September 28, 2004 related to Claims 1-11 have been fully considered but are not persuasive.

In reference to Applicant's argument:

Art Unit: 2121

Mehrotra et al. disclose the structure of a neural network in Fig. 1.14, as noted by the examiner. On page 116, Mehrotra et al. also disclose "pruning" the network, that is, eliminating nodes and connections that are considered unimportant. In Fig. 4.6, Mehrotra et al. describe a generic pruning algorithm, by which nodes or connections are deleted if the removal does not penalize performance beyond a desirable tolerance level. Mehrotra et al. then outline, on pages 116-118, four procedures that can be used to implement the network pruning methodology. None of these procedures includes selecting first and second sending neurons that are connected to the same receiving neuron by respective first and second synapses, assuming a correlation of response signals from said first and second sending neurons to the same receiving neuron, interrupting the first synapse and adapting in its place a weight of the second synapse, comparing the output signals of the changed neural network with the output signals of the unchanged neural network, and if the comparison result does not exceed a predetermined level, eliminating the first synapse, as recited in claim 1.

Examiner's response:

A the applicant acknowledged on page 10, line 18 of the response of August 2, 2004, the "utility of neural networks is well known" which is conclusory to the cause that the "technology is well known" which is exemplified by the text of Mehrotra et al entitled "Elements of Artificial Neural Networks" and cited as prior art in the First Office Action.

The concept of:

selecting first and second sending neurons that are connected to the same receiving neuron by respective first and second synapses, assuming a correlation of response signals from said first and second sending neurons to the same receiving neuron,

is a description of section of a network that was identified in Mehrotra @ Fig. 1.14. A general neuron model can be found in Mehrotra @ Fig. 1.4 with a weighted input summation identified in Mehrotra @ Fig. 1.5 and with correlation to synapses identified in Mehrotra @ Fig. 1.3. Simply stated, neural networks are massively parallel devices wherein as Mehrotra illustrates, in Fig. 1.14, two neurons are connected to a third (receiving) neuron wherein correlation is taking place through the additive function as Mehrotra illustrates @ Fig. 1.5. The concept of:

interrupting the first synapse and adapting in its place a weight of the second synapse, comparing the output signals of the changed neural network with the output signals of the unchanged neural

Art Unit: 2121

network, and if the comparison result does not exceed a predetermined level, eliminating the first synapse

is a description of pruning such as described in Mehrotra @ para 4.2.1 to include Fig. 4.6 which is a genetic network pruning algorithm. From a typical neural network such as that shown by Mehrotra @ Fig. 1.14, if a neuron of the perceptron type identified by Mehrotra @ fig. 2.5 is removed, and there were only two connection to the receiving neuron as the applicant suggests, the only remaining element to the receiving neuron is the other perceptron which is influenced by the weight of the second perceptron. Returning now to Mehrotra @ Fig. 4.6 and the genetic network pruning algorithm, Mehrotra removes the node (neuron - synapse) as long as the removal does not penalize performance beyond a desirable tolerance level. Hence, Mehrotra anticipates the applicant's claim 1.

In reference to Applicant's argument:

The first procedure calls for eliminating connections having weights of small magnitude, as well as eliminating their associated nodes. Presumably, this procedure involves comparing synapse weights against a threshold, and eliminating synapses having weights below the threshold. Mehrotra et al., in describing this procedure, do not disclose selecting two sending neurons, assuming a correlation, interrupting a synapse and adapting a weight of another synapse, comparing reactions of the network, and then eliminating a synapse, as required by claim 1. In contrast, this procedure merely checks the weights of synapses in making a determination of whether to eliminate the synapse. Thus, this procedure does not anticipate the invention recited in claim 1.

Examiner's response:

Mehrotra states @ para 4.2.1: "Nodes whose associated connections have small magnitude weights may also be pruned." This combined with the Mehrotra genetic network pruning algorithm @ Fig. 4.6 is equivalent to eliminating weights below a threshold.

Art Unit: 2121

In reference to Applicant's argument:

The second procedure calls for determining the effect that a change in the synapse weight has on network output, and eliminating synapses if the change is acceptable. The change in synapse weight is not disclosed to be based on a weight of another synapse having a different sending neuron and the same receiving neuron, as required by claim 1. Further, no pair of neurons is selected for weight adaptation and no correlation assumption is made, also as required by claim 1. Thus, this procedure does not anticipate the invention recited in claim 1.

Examiner's response:

The network is made up of a plurality of nodes and when a connection weight is changed to zero and the output is observed will of course be comparable to other synapses since the process is made in the plurality. The network is made up of a plurality of neurons and therefore there is a plurality of pairs of neurons and such pairs will be selected for weight adaption. Correlation is by addition and such correlation is identified by Mehrotra @ Fig.2.5. Further, since claim 1 "assumes correlation" this means that from the perspective of the applicant, correlation may not be there and hence correlation is not a limiting criteria by the applicant.

In reference to Applicant's argument:

The third procedure calls for pruning input nodes, and does not address identifying and eliminating synapses. Thus, this procedure does not anticipate the invention recited in claim 1.

Examiner's response:

Pruning input nodes removes the synapses to other neurons. See Mehrotra @ Fig. 1.3.

In reference to Applicant's argument:

Art Unit: 2121

The fourth procedure calls for identifying weights to be pruned from a network by examining the second derivatives of the error function contained in the Hessian matrix, using a formula to approximate the change in output resulting from a small perturbation in a selected weight. Pairs of neurons are not selected, weights are not substituted, and actual changes based on the substitution are not made, as required by claim 1. Thus, this procedure does not anticipate the invention recited in claim 1.

Examiner's response:

Indeed all of the applicant's objections are satisfied by Mehrotra. The network is made up of a plurality of neurons and consequently there are a plurality of pairs of neurons; a plurality of first and second neurons; "pair" is not used by the applicant in claim 1. When a neuron is removed, the weight of the nearby neuron takes its place ... this is axiomatic in any neural network. Changes based on substitution are made since the removal of a neuron causes substitution of a nearby neuron weight ... again it is axiomatic.

In reference to Applicant's argument:

In summary, Mehrotra et al. describe four pruning procedures for simplifying a neural network. None of these procedures includes all of the elements of the method recited in claim 1. That is, none of the disclosed procedures includes the process of selecting first and second sending neurons that are connected to the same receiving neuron by respective first and second synapses, assuming a correlation of response signals from said first and second sending neurons to the same receiving neuron, interrupting the first synapse and adapting in its place a weight of the second synapse, comparing the output signals of the changed neural network with the output signals of the unchanged neural network, and if the comparison result does not exceed a predetermined level, eliminating the first synapse, as recited in claim 1.

Examiner's response:

Above discussions apply. Mehrotra fully anticipates the applicants disclosure.

Examiner notes that while each point made by the applicant has been answered, it was necessary to only show that Mehrotra taught one process that anticipated the applicant's invention.

Art Unit: 2121

In reference to Applicant's argument:

Claims 2-11 depend from claim 1, and therefore also are not anticipated by Mehrotra et al., for the reasons noted with respect to claim 1, and in view of the additional features recited in the dependent claims. For example, claim 2 recites that the first and second selected sending neurons are located on the same layer. The examiner noted that Mehrotra et al. disclose sending neurons located on the same layer, in Fig. 1.14. Fig. 1.14 does show that sending neurons exist on the same level, but not that two sending neurons selected as part of the process recited in claim 1 are located on the same layer, because that process is not disclosed by Mehrotra et al.

Examiner's response:

Since Mehrotra does anticipate the applicant's claim 1, the applicant concurs that Mehrotra anticipates claims 2-11.

Examination Considerations

13. The claims and only the claims form the metes and bounds of the invention.

"Office personnel are to give the claims their broadest reasonable interpretation in light of the supporting disclosure. *In re Morris*, 127 F.3d 1048, 1054-55, 44USPQ2d 1023, 1027-28 (Fed. Cir. 1997). Limitations appearing in the specification but not recited in the claim are not read into the claim. *In re Prater*, 415 F.2d, 1393, 1404-05, 162 USPQ 541, 550-551 (CCPA 1969)" (MPEP p 2100-8, c 2, I 45-48; p 2100-9, c 1, I 1-4). The Examiner has full latitude to interpret each claim in the broadest reasonable sense.

Examiner will reference prior art using terminology familiar to one of ordinary skill in the art. Such an approach is broad in concept and can be either explicit or implicit in meaning.

14. Examiner's Notes are provided to assist the applicant to better understand the nature of the prior art, application of such prior art and, as appropriate, to further

Art Unit: 2121

indicate other prior art that maybe applied in other office actions. Such comments are entirely consistent with the intent and spirit of compact prosecution. However, and unless otherwise stated, the Examiner's Notes are not prior art but a link to prior art that one of ordinary skill in the art would find inherently appropriate.

15. Examiner's Opinion: Paras 13. and 14. apply. The Examiner has full latitude to interpret each claim in the broadest reasonable sense.

Conclusion

16. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

17. A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Art Unit: 2121

18. Claims 1-11 are rejected.

Correspondence Information

Any inquiry concerning this information or related to the subject disclosure should be directed to the Examiner, Joseph P. Hirl, whose telephone number is (571) 272-3685. The Examiner can be reached on Monday – Thursday from 6:00 a.m. to 4:30 p.m.

If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor, Anthony Knight can be reached at (571) 272-3687.

Any response to this office action should be mailed to:

Commissioner of Patents and Trademarks,

Washington, D. C. 20231;

or faxed to:

(703) 872-9306 (for formal communications intended for entry);

or faxed to:

(571) 273-3685 (for informal or draft communications with notation of "Proposed" or "Draft" for the desk of the Examiner).


Joseph P. Hirl

November 18, 2004


Anthony Knight
Supervisory Patent Examiner
Group 3600